AIR SAMPLING FOR PARTICULATE MASS USING THE VOLUMETRIC AIR SAMPLERS

Purpose

This Meteorology and Air Quality Group (MAQ) procedure describes the siting, setup, calibration, maintenance, and operation of several models of samplers used for the sampling of TSP and PM-10 particle mass.

Scope

This procedure applies to the individuals assigned to operate and maintain the high-volume air samplers for sampling of TSP or PM-10 particles from burns at LANL, controlled burns on Bandelier and Forest Service lands, wildfires in the immediate area, and measurement of airborne particles at other sites as needed.

In this Procedure

Hazard Control Plan

The hazard evaluation associated with this work is documented in Attachment 1: Initial risk = **low**. Residual risk = **low**. Work permits required: **none**. First authorization review date is one year from group leader signature below; subsequent authorizations are on file in group office.

09/30/02

Signatures *(continued on next page)*

Prepared by: Alice Baumann, MAQ Group	Date: 9/3/02
Approved by: Craig Eberhart, Air Quality Monitoring Project Leader	Date: 9/9/2002
Work authorized by: Jean Dewart, MAQ Acting Group Leader	Date: 9/10/2002

General information about this procedure

Signatures, *continued*

Approved by:	Date:
Terry Morgan, Quality Assurance Officer	9/10/02

Attachments

This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	Hazard Control Plan	2
2	Heavy Metal Analytical Request Form	1
3	PM-10 Data Form	1
4	Example of Spreadsheet for PM-10 Calibration	1
5	Example of Spreadsheet for PM-10 Flow Checks	1

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description of Changes
0	4/15/98	New document.
1	1/6/00	Added several chapters and three attachments.
2	9/19/02	Added chapter for weighing of filters, revised all other chapters to address other types of samplers.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- Field workers doing hi-volume air sampling

Training method

The training method for this procedure is **on-the-job** training given by a previously trained individual, and is documented in accordance with the procedure for training (MAQ-024).

General information, continued

Definitions specific to this procedure

TSP: The Hi-Volume air sampling instrument that collect total suspended particulates without any separation of particle sizes.

PM-10: The air monitoring instrument that collects solid airborne particles of 10 μm and less. Ten μm is the largest sized solid particle that can find its way into the human lungs through the normal nose-mouth breathing passages.

References

The following documents are referenced in this procedure:

- MAQ-024, "Personnel Training"
- MAQ-011, "Logbook Use and Control"

Note

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").

Worker safety

Performing work safely

DO NOT perform work under conditions you consider unsafe. Before beginning work described in this procedure, review safety needs and requirements, identify hazards, and develop hazard mitigation measures. Be aware that facility configurations and hazards may change between visits. Hazards to assess include, but are not limited to the following:

Facility management units - Work control is the responsibility of the Facility Manager in whose area one may want to locate a sampler. Obtain approval from facility management before beginning work to locate a sampler in a Facility Management Unit**.** Facility management must also have knowledge of your presence and activity during subsequent normal operations. Ensure you have completed all facility-specific training requirements.

Loading and unloading the samplers – Use caution when loading and unloading the samplers; two people should be used.

Contact your supervisor and the project leader if working conditions are found to be unsafe.

Determining sampling site

Monitoring site determination

Samplers may be used for a variety of applications. The **Air Quality Monitoring Project Leader** will determine the location, in cooperation with the Operating Permit Project Leader, a staff investigator, and/or a meteorologist, depending on the purpose of a burn or a study. If a source will be producing emissions over a period that includes day and nighttime conditions, "downwind" may include several separate directions from the source. Criteria for specifically locating samplers after the general area has been selected are based on 40 CFR Part 58, Subpart B. Part 58.12 refers to Appendix E of Part 58, paragraph 8.0, Particulate Matter (PM10 and PM2.5).

Steps to place a sampler

To place a sampler, perform the following steps:

Step	Action
1	Obtain power. If possible, locate the sampler near a source of electrical power. In some cases, a qualified electrician or an electrical technician must be consulted for power hook-up or routing. If the sampler must be located where commercial power is not available, a generator may be used, but must be located downwind from the sampler.
2	The optimum height for placement of the inlet is average breathing height, but a range of two to seven meters above ground level is permitted. This may dictate the placement of the sampler on top of a building, which may be the optimum location.
3	The sampler must be placed at least twice the height of an object, such as a building or tree, away from that object. This will include a 2nd story rising above a roof top location. In general, if the sampler must be placed in a wooded or semi-wooded area, this requirement must be carefully considered because close obstructions break up the air flow and will result in unpredictable particulate sampling.
4	Use a GPS unit to collect site location coordinates.

Setting up sampler and collecting samples

Transporting the PM-10 impactor

Transport the PM-10 impactor (upper half of sampler) in an upright position, with the two halves of the sampler separated and secured. There is an oil coating inside the cascade baffles of the upper half that may become unevenly distributed if the impactor is laid on its side for any length of time. This will adversely affect the particle collection accuracy of the instrument.

Steps to set up the sampler

To set up the sampler, perform the following steps:

Step	Action
1	Ensure the sampler has been calibrated (see one of these chapters *Calibrating samplers with a fixed calibration orifice* or *Calibrating samplers with a variable flow orifice*). If not, perform a calibration or select a calibrated unit.
2	Set up sampler at desired location. Be sure to set firmly on the ground and use sandbags to secure it, or attach to a solid object (e.g., stakes or fence posts). Low-profile HVAC units on roof tops may be used since they typically do not extend above the air inlet height and should not disrupt the air flow around the inlet.
3	If necessary, have a qualified electrician or electrical qualified field worker install electrical conduit and wiring.

Burn monitoring

For PM-10 sampling of burns using the EPA Protocol, the sampler is always started at midnight and run for 24 hours. This is so the 24 hours the sample is taken falls on the same date, not a combination of two days.

Setting up sampler and collecting samples, continued

Equipment needed for PM-10 sampling

For PM-10 sampling, in addition to the equipment listed in the chapters on calibrating the samplers on page 11 or 13, the following material is required to do particulate air monitoring:

- stamped and pre-weighed 8" x 10" filters of appropriate material (e.g., cellulose or microquartz).
- supply of envelopes consisting of two brown manila envelopes; one to hold the exposed microquartz filter and the Request Form, with a larger one that is used as an outer envelope for mailing. The smaller envelope has a stamp block used to record pertinent monitoring data for use by the analysis lab.
- 8½" x 11" glassine envelopes.
- if appropriate, Scientific Laboratory Division Heavy Metal Analytical Request Form (Attachment 2)
- PM-10 Data Form (Attachment 3)

Equipment needed for TSP sampling

For TSP sampling, in addition to the equipment listed in the chapters on calibrating the samplers on page 11 or 13, the following material is required to do particulate air monitoring:

- pre-weighed 8" x 10" filters of appropriate material (e.g., cellulose or microquartz).
- 8½" x 11" glassine envelopes.
- Ziplock bags to hold glassine envelopes.
- Field Data Form and Chain-of-Custody Record (printed from AIRNET database).

Steps to install filter and prepare for sampling

To install a filter and prepare for sampling, perform the following steps:

Step	Action
1	Loosen the four corner knurled nuts from the filter holder. Remove the top half of the filter holder. **Note**: It is advisable to use a spare filter cassette and load it in a protected place before taking it to the sampler. A snap-on cover may be used to protect the filter. This minimizes the time the filter is exposed to ambient air and unnecessary contamination danger.

Steps continued on next page.

Setting up sampler and collecting samples, continued

Step	Action
2	Place filter on to holder (with sample number facing down) and reinstall the top half of the filter holder. Tighten the four knurled nuts firmly (do not over-tighten.)
3	Connect sampler to GFCI-equipped power source or use a GFCI extension cord. Double check connections before energizing equipment. Use only "W" (wet) rated extension cords.
4	Turn the power switch on and allow the motor to run for at least 5 minutes.
5	For samplers with adjustable flows, adjust the flow rate control knob so the rotometer reads 40 cfm. For critical orifice devices, the calibrator may be used determine flow.
6	If equipped, reset the timer by pressing reset button.
7	If so equipped and if needed for the type of sampling being performed, set the timer on the sampler to come on at the required time. Otherwise, start the sampler manually.
8	For monitoring controlled burns and if time permits, collect a 24-hour (midnight-to-midnight) sample on the day prior to the burn.
9	Record necessary start information on the chain-of-custody form or electronic computer device.
10	If samples will be analyzed by the State Scientific Laboratory Division, record on the SLD Analytical Request Form (see Attachment 2): • User code: MAQ's code is 64000 • Date and time of sample collection • User's site ID: in Los Alamos County this is 3ZC • Location of sampler • Identification of sampler • Filter size and identifying number • Analyses requested

Enter sampling event data in database

Ensure the data about the sampling event is entered into the appropriate Access database. Obtain the field data sheet or chain-of-custody form for the sampling event. Contact the database owner (analytical chemistry coordinator) for assistance.

Setting up sampler and collecting samples, continued

Steps to collect filters

To collect filters after a sampling period, perform the following steps:

Step	Action
1	When sample time is complete, record the final timer reading and final flow rate readings (on samplers so equipped) on the chain-of-custody form or field data sheet. Read the flow on the rotometer (if so equipped) or use a calibrator to measure the flow.
2	Turn off the sampler.
3	Take the cassette to a place of relative protection from further dust contamination.
4	Remove the cover, separate the cassette halves, and carefully remove the filter.
5	For PM-10 sample filters, fold the filter along its long axis with the particulate sample to the inside and insert it into a glassine envelope. Having put the filter number facing down when installing the filter at set-up time, it is now visible through the glassine envelope. For TSP sample filters, place into the glassine envelope without folding.
6	If required, perform the calculations on the PM-10 Data Form (Attachment 3) to check that the flow rate is within the required range. Use the average barometric pressure and temperature if in Los Alamos. Measure actual temperature and pressure if at an area that does not have a published average.
7	Place the PM-10 Data Form in the PM-10 Logbook.
8	Retain a copy of the Scientific Laboratory Division Heavy Metal Analytical Request Form (Attachment 2). Place the original, when returned, in the logbook.
9	If the flow rate must be calculated for the sampling event, record on the PM-10 Data Form (Attachment 3) (this will be used as the worksheet to calculate mass concentration): • Site name and code • Sampler ID • Filter ID • Initial and final timer readings ; sampling time in minutes • Initial and final delta P (manometer readings – see the chapter *Setting up sampler and collecting samples*) • Filter weight in grams – initial and final (from SLD) and mass PM-10 collected • Flow Rate Calculation in m^3/min • Mass Concentration = (flow rate)(run time in min.)(PM-10 in grams)(10^6 µg/g)

Calibrating samplers

Methods of calibration

There are different samplers in use in the group and each has a slightly different method of calibration. Follow the method in this chapter to calibrate samplers with a fixed calibration orifice. The next chapter covers calibration of samplers with variable orifices.

Check calibration expiration

The volumetric air sampler must have been calibrated within the previous one year before use. Re-calibration is required whenever changes are made that may affect the air flow through the instrument, such as changing a motor or motor brushes. Before using a sampler, check the date of the last calibration. If the date is more than one year prior to the planned sampling date, the sampler must be calibrated. Also check the logbook for the most recent flow check. Complete a flow check data form within one month of a sampling event.

Calibrating the calibrated orifices

Volumetric air samplers can be calibrated with either a variable flow orifice or a fixed orifice and various restrictor plates.

MAQ maintains several calibrated orifices, which are used to calibrate the volumetric air samplers. Fixed orifices have cylinders with an approximately 1 ⅛" hole in the top and a flat flange on the bottom with a large internally threaded mounting ring, and a small brass fitting for attaching the tubing to a manometer. A variable flow orifice has a knob on the top of the cylinder that controls the variable resistance valve at the bottom of the orifice.

These orifices must be calibrated annually by the New Mexico Environment Department's NIST-traceable calibrations laboratory. Ship each orifice annually on a rotating basis so that a recently calibrated orifice is always available to use for high volume air sampler calibrations.

Calibrating samplers with a fixed calibration orifice

Equipment needed to calibrate

If a calibrator flow meter is NOT used, a Hi-Vol fixed orifice Calibration Kit, which includes the following equipment, is needed:

- two digital manometers with connection tubing
- set of 5 resistance plates with holes for air passage (one each with 10, 11, 13, 15, and 18 holes)
- a fixed calibrated orifice (as described above)
- the orifice adapter plate (black metal, flat based, with a permanent gasket and a large threaded mounting collar in the center)
- a calibrated hand held digital barometer
- a calibrated precision thermometer
- a laptop with Excel program to record and compute calibration data.

Steps to calibrate the volumetric sampler

If a calibrator flow meter is NOT used, to calibrate the volumetric air sampler, perform the following steps:

Step	Action
1	Install new filter holder, and filter holder adapter (depending upon sampler design) into the pump intake.
2	Start the motor and allow it to run and warm up for five minutes.
3	While the motor is warming up, record the atmospheric pressure as indicated by the digital barometer. In Los Alamos, a close area barometric reading can be obtained from the meteorology section if your sampler location is on one of the mesa tops and therefore at or near the same elevation as a met station.
4	Record the temperature as measured using the thermometer.
5	Zero the digital manometers by turning the silver knob. After the motor has warmed up for at least five minutes, attach the plastic hose from one manometer to the outlet on the left side of the sampler body. This point reads the stagnation pressure between atmosphere and just below the filter or variable plate location.
6	Position the orifice adapter plate with the fixed orifice mounted to the plate on the sampler at the filter cassette location and tighten the six nuts firmly. Do not over tighten.

Steps continued on next page.

Calibrating samplers with a fixed calibration orifice, continued

Step	Action
7	Install one of the resistance plates with holes in it over the collar on the base plate. Place the calibrated orifice over the plate and screw the large mounting ring down snugly. Do not over tighten.
8	Attach the plastic hose from the other manometer onto the fitting of the calibrated orifice cylinder.
9	Record both of the manometer readings.
10	Repeat steps 6 through 9 for each plate.
11	The Excel program will calculate the slope “m” and the intercept “b”.
12	The “sampler r” must be above 0.995 for the sampler to be considered calibrated. If not, repeat the measurements and calculations; check for leaks if still under specification.
13	Place a copy of the printout of the spreadsheet in the PM-10 Logbook so it is available for continuous reference. The slope and intercept figures must be used whenever a flow rate measurement is made.

Calibrating samplers with a variable flow orifice

Equipment needed to calibrate

If a calibrator flow meter is NOT used, a variable orifice calibration kit is needed, which includes the following equipment:

- two digital manometers with connection tubing
- a variable flow calibrated orifice (as described above)
- the orifice adapter plate (black metal, flat based, with a permanent gasket and a large threaded mounting collar in the center)
- a calibrated hand held digital barometer
- a calibrated precision thermometer
- a laptop with Excel program to record and compute calibration data.

Steps to calibrate the air sampler

If a calibrator flow meter is NOT used to calibrate the volumetric air sampler, perform the following steps:

Step	Action
1	Place filter media in the filter holder and onto the sampler filter support screen. **IMPORTANT**: Ensure you are using the same filter media as will be used for sample collection.
2	Start the motor and allow it to run and warm up for five minutes.
3	While the motor is warming up, record the atmospheric pressure as indicated by the digital barometer. In Los Alamos, a close area barometric reading can be obtained from the meteorology section if your sampler location is on one of the mesa tops and therefore at or near the same elevation as a met station.
4	Record the temperature as measured using the thermometer.
5	Zero the digital manometers by turning the silver knob. After the motor has warmed up for at least five minutes, attach the plastic hose from one manometer to the outlet on the left side of the sampler body. This point reads the stagnation pressure between atmosphere and just below the filter or variable plate location.
6	Attach the tubing from the manometer to the stagnation port on the side of the sampler and record the pressure difference.
7	Remove the filter holder and install the orifice adapter plate to the filter cassette location with the variable orifice mounted onto the plate.
8	While still reading the manometer from the stagnation port, adjust the variable orifice by turning the knob on the top, until it equals the original reading with the filter installed and record the pressure difference.

Steps continued on next page.

Calibrating samplers with a variable flow orifice, continued

Step	Action
9	Attach the other manometer to the pressure tap on the orifice and record the pressure difference from the orifice.
10	Adjust the flow rate by turning the knob of the variable orifice to include at least three other calibration points. Record manometer readings from both the stagnation port and orifice pressure tap. **Note**: one manometer reading should be at a higher flow rate (lower stagnation port manometer reading) than the original calibration point and the other manometer readings should be at lower flow rates (higher stagnation port manometer readings).
11	The Excel program will calculate the slope "m" and the intercept "b". (see Attachment 4, "Example of Spreadsheet for PM-10 Calibration").
12	The "sampler r" must be between 0.996 and 1.0 for the sampler to be considered calibrated.

Steps to perform the flow check

An Excel program is available to compute and document the flow check.

Using the Hi-Vol Calibration Kit, perform the following steps:

Step	Action
1	Start the motor and allow it to run and warm up for five minutes.
2	While the motor is warming up, record the atmospheric pressure as indicated by the digital barometer.
3	Record the temperature as measured using the thermometer.
4	With a filter and filter cassette in place, attach a manometer to the side of the sampler and record the Delta P.
5	Remove the top of the filter cassette, leaving the lower half and the filter in place and attach the orifice adapter plate and the orifice.
6	Attach the other manometer to the orifice and read and record both manometer readings.
7	The spreadsheet can calculate the actual sampler flow. It must be within 10% of 1.13 m^3/min for PM-10 and between 1.13 to 1.274 m^3/min for TSP flows.
8	Apply a label to the sampler that indicates the date of calibration.
9	Ensure the above data are recorded in the logbook.

Weighing filters

Need for weighing

Filter material is weighed before and after sample collection to determine the mass of particles collected. The filter material absorbs moisture from the air and thus gains and loses weight as the humidity changes. The filters must be thoroughly dried before samples are weighed. For some programs, this weighing is done by an outside laboratory and this chapter is not performed by MAQ personnel.

Drying chambers

In the Cave at TA-54, there are two clear plastic drying chambers that contain desiccant. Shelves in these chambers can hold several 8 x 10 filters for drying. One chamber is for clean filters and the other is for sampled filter samples.

Keep the chambers clean to minimize potential cross-contamination. Periodically check the condition of the desiccant and replace if in doubt about its condition. Keep the relative humidity meter in one of the chambers as a check on the dry conditions.

Label the filters

Select a 8 x 10" filter and a 8½ x 11" glassine envelope. Label the filter number (usually a sequential number) on the envelope only. Record the filter number in a table in the logbook. Keep the envelope with the filter at all times to identify the filter.

Dry the filters

Remove the filter material from the glassine envelope (filters will not dry completely if inside the envelope), place the envelope on a shelf, and place the filter on top of its envelope. Leave the filters in the drying chamber at least 24 hours to ensure complete drying.

Steps to weigh a filter

To weigh a filter, perform the following steps:

Step	Action
1	Ensure that the filters have been in the drying chamber, removed from their glassine envelopes, for 24 hours and that the desiccant in the box is not saturated.

Steps continued on next page.

Weighing filters, continued

Step	Action
2	Open the lid on the scale and place the check weights on balance to verify proper operation of the balance. This may be done only once for a weighing session.
3	Remove the filter to be weighed from the drying chamber (keep the filter flat and level to avoid displacing any material on it) and place it onto the wire support on the scale. Close the lid on the scale.
4	If the scale shows the filter is losing weight, this means the filter was not dry enough. Put the filter back into the drying cabinet for another day. If the scale shows the filter is gaining weight, take the first reading from the scale after the scale has stabilized (generally after no more than 30 seconds).
5	Record in the logbook (follow requirements for logbook entries in MAQ-011): • Results of check weights readings • Filter number and location where sample collected • The weight of the filter • Humidity and temperature reading from meter in dry box • Initials and date.
6	Remove the filter from the balance support and carefully slide it into its glassine envelope.
7	Continue with step 3 for the next filter to be weighed.

Analyzing filters

Sending filters for analysis

For some programs, filters are mailed to the State Health Department Scientific Laboratory Division. For the NonRad air program, filters are sent to Grand Junction Office Analytical Laboratory (formerly Wastren-Grand Junction) in Grand Junction, CO.

State Scientific Laboratory

For filters to be analyzed by the State Health Department Scientific Laboratory Division, place the glassine envelope containing the exposed quartz filter from the PM-10 Sampler and the Scientific Laboratory Division Heavy Metal Analytical Request Form (Attachment 2) into one of the smaller sized brown envelopes (see "Equipment needed" on page 9). Record the information asked for on the stamping. Mail to 700 Camino de Salud, Albuquerque, NM, 87106.

Grand Junction Office Analytical Laboratory

For the NonRad air monitoring program, send filters to Grand Junction Office Analytical Laboratory (formerly Wastren-Grand Junction) in Grand Junction, CO.

Replacing motor brushes

When to replace brushes

Some samplers have motors that require replacement of the brushes. For these motors, replace the brushes after each 100 hours of operation.

Steps to replace brushes in Wedding

To replace brushes in a Wedding & Associates or Thermo Environmental Instruments air sampler motor, perform the following steps:

Step	Action
1	With the sampler unplugged, release the 2 snap locks at the inside/top of the PM-10. The critical throat device will swing out to 45^{o}.
2	At the bottom of the critical throat device, unscrew the four knurled nuts and slide out the vacuum motor.
3	Remove the brushes by removing the screws and the bracket that holds the brush in place and, with a screwdriver, pry out the flat tab connector.
4	Replace brushes and reverse step 3.
5	Plug motor into a variable transformer. Run motor for 5-10 minutes at 50%, then at 100% for 5 minutes.
6	Replace vacuum motor into the bottom of the critical throat device.
7	Record maintenance performed in the appropriate logbook.

Steps to replace brushes in Tisch or Thermo-Anderson

To replace brushes in a Tisch Environmental or Thermo Andersen air sampler motor, perform the following steps:

Step	Action
1	With the sampler unplugged, loosen the large hose clamp that secures the motor housing to the support brackets.
2	Unscrew the knurled ring at the bottom of the air flow funnel and remove the critical orifice/motor housing assembly.
3	Remove the screws on top of the motor housing and separate the critical orifice from the motor housing. Loosen the power cord strain relief nut on the side of the motor housing.

Steps continued on next page.

Replacing motor brushes, continued

Step	Action
4	Slide the vacuum motor out of the housing, while allowing the power cord to slip through the hole on the side.
5	Remove the brushes by removing the screws and the bracket that holds the brush in place and, with a screwdriver, pry out the flat tab connector.
6	Replace brushes and reverse step 3.
7	Replace vacuum motor into the motor housing and attach the critical orifice with the four screws. Secure the critical orifice/motor housing by tightening the knurled ring and hose clamp around the support brackets. Tighten the power cord strain relief nut on the side of the motor housing.
8	Plug motor into a variable transformer. Run motor for 5-10 minutes at 50%, then at 100% for 5 minutes.
9	Record maintenance performed in the appropriate logbook.

Records resulting from this procedure

Records

The following records generated as a result of this procedure are to be submitted as records to the records coordinator annually:

- maintenance work entries in logbooks (logbooks will be maintained and submitted according to MAQ-011)
- maintenance work entries in the logbooks
- spreadsheet for PM-10 Calibration
- spreadsheet for PM-10 Flow Check
- Scientific Laboratory Division Heavy Metal Analytical Request Form
- PM-10 Data Form

HAZARD CONTROL PLAN

1. The work to be performed is described in this procedure.
"Air Sampling Using The Volumetric Air Samplers"

2. Describe potential hazards associated with the work (use continuation page if needed).

Handling heavy objects (loading/unloading/transporting/positioning) – awkward equipment is hard to handle.
Cuts/smashed fingers from top unit mating with bottom or changing brushes -- Lid may fall closed, causing injury.
Falls/tripping on uneven ground.
Animal Injuries (snakes, spiders, mountain lions, etc.)
Weather: lightning, rain.
High Explosives testing in areas such as TA-15, TA-16, TA-49, etc.
Radiation Areas in areas such as TA-54- Area-G, TA-16, etc.
Electrical shock in wet conditions
Electrical shock from damaged electrical conduit via vehicle or animal damage.
Dropping materials on feet

3. For each hazard, list the likelihood and severity, and the resulting initial risk level (before any work controls are applied, as determined according to LIR300-00-01, section 7.2)

Handling heavy objects-- Moderate/occasional = low
Cuts/smashed fingers from top unit mating with bottom or changing brushes--Moderate/Improbable = Minimal
Falls/tripping -- Moderate/Occasional = Low
Animal Injuries -- Critical/Remote = Minimal
Weather -- Catastrophic/Remote = Low
High Explosives testing -- Critical/Remote = Minimal
Radiation Areas – Negligible/Remote = Low
Electrical shock in wet conditions – Catastrophic/Remote = Low
Electrical shock from damaged electrical conduit via vehicle or animal damage — Critical/ Improbable= Low
Dropping materials on feet – critical / improbable = low

Overall *initial* risk: ☐ Minimal ☒ Low ☐ Medium ☐ High

4. Applicable Laboratory, facility, or activity operational requirements directly related to the work:
☐ None ☒ List: Work Permits required? ☒ No ☐ List:
LIR 402-7-6-01 "Personnel Dosimetry"
LIR 402-718-01 "Radiological Training"
Access Control Requirements for applicable areas or FMUs
29 CFR 1926.500, Subpart M, Section 502, "Fall protection"
National Fire Protection Code--for use of electrical GFCIs.
LIR 402-600-01 "Electrical Safety" for all electrical hazards. LIG402-10-01A, "Lightning Safety"

HAZARD CONTROL PLAN, continued

5. Describe how the hazards listed above will be mitigated (e.g., safety equipment, administrative controls, etc.):

Handling heavy objects: use proper lifting techniqes, wear gloves when handling sharp or rough parts, and use common sense. Two people are highly recommended when moving the sampler.
Falls/tripping -- "Employee Orientation" includes training and awareness; use common sense.
Animal Injuries -- "Employee Orientation" includes training and awareness.
Weather (lightning)—Be aware of developing weather as described in employee orientation material.
Entry into High Explosives testing areas -- existing controls are stringent and not easily bypassed. Existing facility controls include site-specific training, sign-in/sign-out, and scheduling procedures.
Entry into posted Radiation/Controlled Areas--Example: TA-54-Area-G and TA-15 controls are stringent and not easily bypassed. Area-G and TA-15 require entry through manned access control.
Cuts/smashed fingers from top unit mating with bottom or changing brushes--Use due caution.
Electrical shock in wet conditions — Only use extension cords with GFCI.
Electrical shock from damaged electrical conduit via vehicle or large animal-- the administrative control requires that JCI be contacted to shut power off prior to any further work. Do not approach the unit if there is any obvious damage and where there could be a potential for electrical shock.
Dropping materials onto feet -- Steel-toed shoes or boots are required anytime pumps, station houses, timbers, or other heavy equipment is moved.

6. Knowledge, skills, abilities, and training necessary to safely perform this work (check one or both):

☒ Group-level orientation (per MAQ-032) and training to this procedure.

☒ Other → See training prerequisites on procedure page 3. Any additional describe here:

7. Any wastes and/or residual materials? (check one) ☒ None ☐ List:

8. Considering the administrative and engineering controls to be used, the *residual* risk level (as determined according to LIR300-00-01, section 7.3.3) is (check one):

☐ Minimal ☒ Low ☐ Medium (requires approval by Division Director)

9. Emergency actions to take in event of control failures or abnormal operation (check one):

☐ None ☒ List:

For any injury, provide first aid and see that injured person is taken to Occupational Medicine (if injury does NOT require immediate medical attention) or the hospital. For any exposed, energized electrical wires, contact JCI or the appropriate authority to turn power off. Follow all site specific emergency plans for any radiation or explosives emergencies.

Signature of preparer of this HCP: This HCP was prepared by a knowledgeable individual and reviewed in accordance with requirements in LIR 300-00-01 and LIR 300-00-02.

Preparer(s) signature(s)	Name(s) (print) /Position	Date

Signature by group leader on procedure title page signifies authorization to perform work for personnel properly trained to this procedure. This authorization will be renewed annually and documented in MAQ records. Controlled copies are considered authorized. Work will be performed to controlled copies only. This plan and procedure will be revised according to MAQ-022 and distributed according to MAQ-030.

HEAVY METAL ANALYTICAL REQUEST FORM

Meteorology And Air Quality Group

PM-10 DATA FORM

This form is from MAQ-224

Site Name _____ **Site Code** _____ **Sampler No.** _____

Sample date Mo _____ **Dy** _____ **Yr** _____ **Filter No. Q**_____

Sampling Time _____ **min.** **User code** **64000** **Submitter Code** **N/A**

Filter Weight (grams) **Delta P1 (in. H_2O)** **Delta P1 (mm Hg)**

Initial _____ **Initial** _____

Final _____ **Final** _____

PM-10 _____ **Average** _____ **x 1.87 =** _____

Delta P1 is the difference between ambient pressure and the pressure below the filter.

1 inch = 25.4 mm **Hg is 13.6 times as heavy as water.**

Flow Rate Calculation: P1 = Pa - Delta P1 = _____ **-** _____ **=** _____ **mm Hg**

Q_a = [{(P1/P_a) x SQRT (T_a)} - b] / m = _____ **m^3/min**

Mass Concentration = (flow rate)(run time in min.)(PM-10 in grams)(106 µg/g)

Use monthly averages for P_a and T_a as listed below. Terms "m" and "b" should be posted on each sampler. Action should be taken if the flow is below 1.02 m^3/min.

Site	Pres	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1D	604	272	275	276	282	286	292	294	293	288	284	276	272
1U	640	274	277	279	285	290	295	297	297	291	285	278	273
1Z	633	273	276	279	285	288	295	296	296	290	285	277	272
2U	635	274	277	280	285	289	294	296	295	290	286	279	274
3A	593	274	276	279	284	287	293	295	294	289	285	277	272
3HM	593	274	276	279	284	287	293	295	294	289	285	277	272
3ZA	586	269	271	275	280	283	289	291	290	286	282	275	268
3ZC	590	273	274	277	281	285	291	293	291	287	284	276	271
3ZD	598	270	273	276	281	285	291	293	292	287	282	275	270
5ZA	676	280	282	285	290	293	298	299	299	294	289	284	279
5ZH	678	279	280	284	289	293	298	299	299	295	290	283	277
6C	674	280	282	285	289	294	298	300	299	295	291	284	278
6R	673	280	282	285	289	294	298	300	299	295	291	284	278
6ZG	678	280	282	285	289	294	298	300	299	295	291	284	278
7B	627	278	279	281	286	289	295	295	294	291	288	281	277
7D	660	280	282	284	288	293	298	298	298	293	290	282	278
7O	652	280	281	284	288	292	297	298	298	294	290	283	278
7R	628	278	279	281	286	289	295	295	294	291	288	281	277
7S	625	278	279	281	286	289	295	295	294	291	288	281	277